
2.6 – STORM DRAINAGE

(Last revised 02/2017)

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PART 1 – GENERAL

2.6.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions apply to this specification.
- B. Section 2.3 – TRENCHING, BACKFILLING, & COMPACTION OF UTILITIES.
- C. Section 2.5 – SANITARY SEWER
- D. Section 2.8 – SEEDING, SODDING, & GROUND COVER

2.6.2 SUMMARY

This section includes all equipment, labor, material, appurtenances, and services required for complete installation of storm drainage piping, ditches, structures, and specialties for municipal drainage systems.

2.6.3 DEFINITIONS

A. General

For the purposes of this specification, the following definitions refer to storm water drainage systems and structures that come under the authority of the City of Fairfax, Virginia as specified within this section and other sections of this manual.

Public Storm Drainage System: Drainage systems and their appurtenances required for the conveyance of public storm water from and across publicly maintained streets, roads, highways, and other public property and located within public rights-of-way and/or easements.

B. The following are industry abbreviations for various pipe materials.

- 1) **CIP:** Cast Iron Pipe
- 2) **DIP:** Ductile Iron Pipe
- 3) **HDPE:** High Density Polyethylene Pipe

- 4) **RCP:** Reinforced Concrete Pipe

2.6.4 SUBMITTALS

- A. Submit shop drawings on all non-standard products/materials.
- B. Submit product data and shop drawings for the following:
- 1) Drop/curb inlets
 - 2) Frame and covers
 - 3) Head/end walls
 - 4) Inlet grates
 - 5) Pipe and piping specialties
 - 6) Precast concrete manhole castings

2.6.5 QUALITY ASSURANCE

- A. Materials and operations shall comply with the latest revision of all applicable Codes and Standards.
- B. Piping materials shall be marked clearly and legibly.
- 1) Reinforced Concrete Pipe shall be marked as follows, in accordance with AASHTO M 170:
 - a. Pipe class and specification designation,
 - b. Manufacturer's name or trademark,
 - c. Date of manufacture,
 - d. Identification of the plant, and
 - e. "Q Cast" stamp to certify the pipe was produced by an ACPA certified plant.
 - 2) High Density Polyethylene Pipe shall be marked as follows, in accordance with AASHTO M 294:
 - a. Manufacturer's name or trademark,
 - b. Nominal pipe size,
 - c. Designation of "AASHTO M 294",
 - d. Plant designation code, and
 - e. Date of manufacture or an appropriate code.

2.6.6 STANDARD ABBREVIATIONS

AASHTO	American Association of State Highway Transportation Officials
ACPA	American Concrete Pipe Association
ASTM	American Society for Testing and Materials
OSHA	Occupational Safety and Health Administration

2.6.7 PRODUCT DELIVERY, STORAGE AND HANDLING

A. Pipe Condition/Pipe Examination:

- 1) **New Pipe Inspection – All Pipe:** Inspect materials thoroughly upon arrival. Examine materials for damage. Remove damaged or rejected materials from site. Pipe shall be protected during handling against impact shocks and free fall. Pipe shall be kept clean at all times, and no pipe shall be used in the work that does not conform to the appropriate ASTM Specifications.
 - a. **Reinforced Concrete Pipe:** Check bells and spigots closely for smoothness, roundness, and honeycombing (concrete pipe), which may be a source of infiltration. Check for cracks, chips, etc. on both ends. Reject any pipe that will not provide watertight seal or is otherwise structurally deficient.
 - b. **High Density Polyethylene Pipe:** Check that there are no visible cracks, holes, creases, foreign materials, or other injurious defects. Check that there are no corrugated surfaces inside and out, or a corrugated surface outside and a smooth inner liner. Check that the color, density, and other physical properties are uniform along the length of the pipe and that the ends of the pipe cut squarely and cleanly.
- 2) **Pre-Installation Inspection:** Prior to being installed, each section of the pipe shall be carefully examined for damage and conformity with these specifications. All pipes damaged or deemed not to conform to these specifications shall be rejected and removed from site.
 - a. **Concrete Pipe:** All concrete pipes in which the spigots and bells cannot be made to fit properly, or pipe, which has chipped bells or spigots, will be rejected. The faces of all spigots ends and of all shoulders on the bells of rigid pipe must be true.
 - b. **High Density Polyethylene Pipe:** All HDPE pipes must meet the requirements stated in section 2.6.7 A 1 b of this specification.
- B. Protect pipe coating during handling using methods recommended by the manufacturer. Use of bare cables, chains, hooks, metal bars, or narrow skids in contact with coated pipe is not permitted.
- C. Observe manufacturer's directions for delivery and storage of materials and accessories.
- D. Protect stored piping from entry of water or dirt into pipe. Protect bells and flanges of special fittings from entry of moisture and dirt.
- E. Handle precast concrete manholes and other structures according to manufacturer's written rigging instructions.

2.6.8 PROJECT CONDITIONS

Storm Drainage Manholes – No water mains shall pass through or come in contact with any part of a storm drainage manhole. A minimum of 3 feet of horizontal separation shall be maintained between water mains and storm drainage pipes and storm drain manholes unless otherwise approved by the Public Works Director. Interference/conflict manholes will not be permitted unless otherwise approved by the Public Works Director.

2.6.9 LOCATING SERVICES

Contact the City of Fairfax Public Works Department to coordinate interruption of water or sewer services, operation of water valves, line cut-ins etc., which are the result of storm drainage construction. If interruption is necessary, the interruption shall be arranged to occur at such a time to cause the least disruption and minimize loss of service. At the direction of the Public Works Engineer, temporary water or sewer service may be required to be provided. To all citizens affected, provide a minimum of 48 hours written notice of the proposed water or sewer utility interruption or necessary operation of water valves.

2.6.10 COORDINATION

Coordinate tie-in to municipal drainage systems with the City of Fairfax Public Works Director.

PART 2 – PRODUCTS

2.6.11 PIPE & FITTINGS

2.6.11.1 CONCRETE PIPE

A. PLAIN CONCRETE PIPE

Plain concrete pipe should not be used in the design or installation of storm sewer. Only RCP is allowed.

B. REINFORCED CONCRETE PIPE

RCP shall be a minimum of Class III, Wall B. Concrete pipe joints shall be tongue and groove type unless otherwise specified. RCP shall conform to the class as specified and requirements of the applicable sections of the latest revision of the *VDOT Road and Bridge Specifications*.

RCP Class III or IV shall also meet ASTM C76, *Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe*.

Gasketed Joints in Concrete Pipe shall meet ASTM C990, *Standard Specification for Joints in Concrete Pipe, Manholes, and Precast Box Sections Using Preformed Flexible Joint Sealants*, latest revision.

C. CONCRETE FLARED END SECTIONS

Concrete flared end sections shall meet all applicable requirements of AASHTO M170, except those pertaining to design and to the applicable requirements of the latest revisions of the *VDOT Road and Bridge Specifications*. Standard concrete flared end sections shall be manufactured

to the dimensions and configurations shown in the **VDOT Road and Bridge Standards, Volume I and II**. All concrete flared end sections shall be reinforced.

2.6.11.2 DOUBLE WALL HIGH DENSITY POLYETHYLENE PIPE (HDPE)

HDPE double wall pipe shall conform to the requirements of the applicable sections of the latest revision of AASHTO M 294. The maximum size permitted is 48 inches.

HDPE joints shall be bell and spigot type with a rubber gasket complying with ASTM F 477. Joints shall watertight meeting a ASTM D 3212 pressure test.

2.6.12 MISCELLANEOUS APPURTENANCES

2.6.12.1 BEDDING

See [Section 2.3 – Trenching, Backfilling, and Compaction of Utilities](#).

2.6.12.2 CONCRETE BLOCK

Concrete block shall conform to the requirements of ASTM C139, *Standard Specification for Concrete Masonry Units for Construction of Catch Basins and Manholes*.

2.6.12.3 BRICK

Brick shall be hard clay, grade SM, ASTM C32, *Standard Specification for Sewer and Manhole Brick (Made From Clay or Shale)*.

2.6.12.4 GEOTEXTILE FABRIC:

Geotextile fabric shall be protected from mud, dirt, dust, sunlight, and debris during transport and storage. Material shall be inert to commonly encountered chemicals; resistant to mildew, rot, insects, and rodents; and biologically and thermally stable. Geotextile fabric for subsurface installation shall not be exposed to direct sunlight for more than 24 hours before or during installation.

- A. **Filter Fabric for Rip Rap:** Filter Fabric for Rip Rap and Rip Rap Beddings shall conform to the *Geosynthetics* section of the *VDOT Road and Bridge Specifications*, latest revision.
- B. **Fabric for Subsurface Drains:** Non-woven needle-punched fabric for subsurface drains shall conform to the *Geosynthetics* section of the *VDOT Road and Bridge Specifications*, latest revision.

2.6.12.5 MORTAR FOR CONCRETE BLOCK & BRICK

Mortar shall be type M, ASTM C270, *Standard Specification for Mortar for Unit Masonry* and ASTM C144, *Standard Specification for Aggregate for Masonry Mortar*. Mortar shall be prepared from cement in perfect condition and shall be prepared in boxes for that purpose. No mortar that has stood

beyond forty-five minutes shall be used. Proportion by volume for the different types of application shall be as follows:

Brick masonry = 1 part cement to 2 parts sand

Pointing = 1 part cement to 1 part sand

2.6.12.6 MISCELLANEOUS CONCRETE

Concrete Classes (VDOT) to Design Compressive Strength at 28 days (f'c):

Class A4.5	General	4,500-psi
Class A4	General	4,000-psi
Class A3	General	3,000-psi
Class B2	Massive or Lightly Reinforced	2,200-psi

Ready mixed concrete shall comply with ASTM C94, *Standard Specification for Ready-Mixed Concrete*. All exposed concrete shall be air entrained. Concrete strength shall be as specified on standard details and drawings. Unless otherwise specified, all concrete shall be Class A3, minimum.

2.6.12.7 PREFORMED PLASTIC GASKETS (JOINT SEALER)

Sag or flow resistance and Chemical resistance shall meet ASTM C990. Preformed butyl gaskets shall be used with structures meeting ASTM C478, ASTM C990 and AASHTO M199. Preformed plastic gaskets shall equal or exceed "Ram-Nek" as manufactured by the Henry Company, Sealants Division, Houston, TX.

2.6.12.8 PORTLAND CEMENT

Type I, CSA normal, ASTM C150 *Standard Specification for Portland Cement*.

2.6.12.9 PRECAST REINFORCED CONCRETE STRUCTURES

- A. Standard precast drainage units shall conform to the material requirements of AASHTO M199 and the applicable requirements of the latest revision of the *VDOT Road and Bridge Specifications*.
- B. Precast box culverts shall conform to the applicable requirements of AASHTO M259 or M273 and AASHTO's *Standard Specifications for Highway Bridges* and the applicable requirements of the latest revision of the *VDOT Road and Bridge Specifications*
- C. Manholes of precast reinforced concrete shall be designed and manufactured in accordance with ASTM C478, *Standard Specification for Precast Reinforced Concrete Manhole Sections*, or latest revision and the applicable requirements of the latest revision of the *VDOT Road and Bridge Specifications*. Manhole diameters shall be 4-foot minimum. The wall shall be a minimum of 5 inches thick and have a 6-inch minimum base. Manholes shall be of precast concrete manhole risers with a tongue and groove joint and a monolithic precast bottom, except where doghouse bases are to be

used when placing manholes over existing mains. Joints shall be sealed with a minimum of butile mastic in conformance with ASTM C990, latest revision.

Unless otherwise approved by the Public Works Director, manholes will be precast reinforced concrete.

All Manholes shall have extended bases with appropriate reinforcing.

2.6.12.10 MANHOLE FRAMES AND COVERS

Standard Frames and Covers: Manhole frames and covers shall be manufactured from Class 35B gray iron, meeting the requirements of ASTM A48, *Standard Specification for Gray Iron Castings*. Standard manhole frames and covers shall be manufactured to the dimensions and configurations shown in the **VDOT Road and Bridge Standards, Volume I and II**. Manholes castings may be either bituminous coated or plain. The bearing surface of the frames and covers shall be machined and the cover shall seat firmly into the frame without rocking. All castings are to be USA made.

2.6.12.11 DROP INLETS

- A. Drop inlet tops shall be precast and shall conform to the requirements of all applicable sections of the latest revision of *VDOT Road and Bridge Specifications*. Inlet tops shall be manufactured to the dimensions and configurations shown in the **VDOT Road and Bridge Standards, Volume I and II**.
- B. Drop inlet bases shall be precast and shall conform to the requirements of all applicable sections of the latest revisions of the *VDOT Road and Bridge Specifications*.
- C. Unless otherwise approved by the Public Works Director, all drop inlet tops and bases will be precast reinforced concrete.
- D. Inlet Grates shall conform to the requirements of all applicable sections of the latest revision of the *VDOT Road and Bridge Specifications*. Standard frames and grates shall be manufactured to the dimensions and configurations shown in the **VDOT Road and Bridge Standards, Volume I and II**.

2.6.12.12 REINFORCING STEEL

Reinforcing steel shall conform to ASTM A615 *Specification for Deformed Billet-Steel Bars for Concrete Reinforcement*, Grade 60.

2.6.12.13 RIP RAP AND RIP RAP BEDDING

Rip Rap and Rip Rap Bedding shall conform to the *Stone for Masonry, Riprap, Porous Backfill, and Gabions* section of the *VDOT Road and Bridge Specifications*.

2.6.12.14 MISCELLANEOUS STORMWATER APPURTENANCES

All miscellaneous stormwater appurtenances including but not limited to Endwalls and Headwalls, and precast arches shall conform to all applicable sections of the latest revision of VDOT *Road and Bridge Specifications*.

PART 3 – EXECUTION

2.6.13 PIPE INSTALLATION - GENERAL

2.6.13.1 CONSTRUCTION – ALL PIPE

- A. **Trench Width:** Trench width shall be in accordance with the dimensions and configurations shown in the **VDOT Road and Bridge Standards, Volume I and II** and specified in the VDOT *Road and Bridge Specifications*.
- B. **Pipe Laying Direction:** Place piping beginning at low point and progress uphill. Place on grade, with unbroken continuity in invert, horizontally and vertically, and on alignment as indicated on plans. Place bell ends of piping facing upstream. Install gaskets, seals, sleeve, and couplings according to manufacturer's written instructions for using lubricants, cements, and other installation requirements.
- C. **Directional changes in gravity lines:** Use manholes for changes in direction of gravity lines. The Public Works Director may permit horizontal curves in pipe alignment for pipe greater than 48 inches in diameter where pipe has been manufactured with a beveled end.
- D. **Stringing out Pipe:** When pipe is strung out during unloading, it shall be set on high ground and in a position to prevent silt deposits, storm water, or other matter from entering the pipe prior to its placement in the trench.
- E. **OSHA Trench Protection:** Adhere to all OSHA requirements for trench slope protection, particularly Subpart P, *Excavations*, of 29 CFR 1926, latest revision. Trench walls may have vertical sides up to a maximum height of 5 feet above subgrade elevation. Beyond this depth the entire sides must be laid back or a trench box, certified for the depths being used, must be used. Contractor is responsible for determining the proper and applicable slope based on type soil in order to meet Subpart P, *Excavations*, latest requirements. Laying back slopes also applies for areas where the top of the trench box is lower than the top of the bank. Contractor shall employ the services of a Geotechnical engineer for direction and guidance if unstable or difficult soils are encountered. In any event, the Contractor shall hold the City of Fairfax harmless for injuries and/or damages resulting from failure to properly adhere to trench protection regulations/requirements in force at the time of a failure or mishap.
- F. **Pipe Laying:** Pipe shall be bedded per [Section 2.3 – Trenching, Backfilling and Compaction of Utilities](#). The pipe and fittings shall be laid in the trench so that its interior surface shall conform to the grade and alignment as shown on the plans. Pipe laying shall be done in such a way as to disturb as little as possible the pipe that has already been laid. The alignment and grade of the storm main may be field adjusted whenever, in the opinion of the Public Works Director, it is necessary, so long as the changes are consistent with the City of Fairfax policy in affect at the time of the change. Changes in either grade or alignment may only occur at manholes. Where necessary,

the invert grade shall be cambered by an amount sufficient to prevent the development of sag or back slope in the flow line. The amount of camber used will be determined by the developer's engineer. Where bell and spigot pipe is used, recesses shall be excavated to receive the pipe bells.

Before laying, the bell and spigot will be wiped free from any dirt or other foreign matter. All surfaces of the portion of the pipe to be joined, and the factory-made jointing material, shall be clean and dry. Jointing material shall be used as recommended by the pipe or joint manufacturer's specifications. The jointing material or factory-fabricated joints shall then be placed, fitted, and adjusted in such workmanlike manner as to obtain the degrees of water tightness required. Lifting holes shall be plugged according to the manufacturer's recommendations.

Trenches shall be kept as dry as possible during bedding, laying and jointing and for as long a period as required until the trench is backfilled. As soon as possible after the joint is made, sufficient backfill material shall be placed along each side of the pipe to offset conditions that might tend to move the pipe off line or grade. The greatest care shall be used to secure water tightness and to prevent damage to or disturbing of the joints during the backfilling process, or at any other time.

After the trench foundation has been properly graded to receive the pipe, the pipe shall be carefully lowered into the trench with approved methods. Under no circumstances shall the pipe or accessories be dropped or dumped into the trench. All damaged pipe shall be replaced at the Contractor's expense.

At least 4 joints shall be left exposed for inspection purposes during the working day and a suitable ladder affording easy and safe access for such inspection shall be furnished.

Any defects due to settlement shall be made good by the Contractor at his own expense.

- 1) **Flexible Plastic Joint:** Flexible joints shall meet the requirements of paragraph [2.6.12.7, *Preformed Plastic Gaskets*](#).
- 2) **Mortar Joints:** Mortar joints may be used in lieu of preformed plastic gaskets. When mortared joints are specified, the mortar in the joints shall be composed of 1 part Portland cement and 2 parts clean sharp sand with 15% hydrated lime, by volume, added to the mixture. The pipe shall be clean and moist when mortar is applied. The lower portion of the bell or groove shall be filled with mortar sufficient to bring the inner surface flush and even when the next joint is fitted into place. The remainder of the joint shall then be filled with mortar and a bead or ring of mortar formed around the outside of the joint. The application of mortar to the inside of joints may be delayed until fill in completed where the pipe is in excess of 30 inches in diameter. The inside of all mortar joints shall be clean and smooth upon completion of the work. Completed mortar joints shall be cured and protected by permanently wrapping the exposed outside of the mortar joint with a layer of 30# roofing felt or a non-woven Geotextile fabric.

- G. **Temporary Suspension of Work:** When the trench is left for the night or if pipe laying is suspended, the upper end of the pipe shall be plugged to keep out dirt, water, animals and other foreign matter or substances. This plug shall be kept in the end of the pipe line at all times when laying is not in actual progress.
- H. **Cutting or Fitting Pipe:** Whenever a pipe requires cutting to bring a pipe to the required location, the work shall be done in a satisfactory manner with an approved cutting tool or tools which will leave a smooth end at right angles to the axis of the pipe and not otherwise damage the pipe. The method of cutting pipe shall be in accordance with manufacturer's recommendations. Such cuts shall be made by the Contractor without extra compensation.
- I. **Joining pipe of different materials:** Where new pipe ties to an existing pipe of a different type of material, provide fittings or coupling adapters made for the pipe material being joined or provide a concrete collar approved by the Public Works Director. At the Public Works Director's discretion, a manhole may be required to be placed at the joint in lieu of a concrete collar.
- J. **Joining pipe of different sizes:**
- 1) Connections shall be made in a workmanlike manner without damage to the main conduit and lateral lines shall not be allowed to protrude beyond the inner wall of the conduit. These joints shall be neatly and tightly made with Portland cement mortar. Taps are not to be made to the line unless approved by the Public Works Director.
 - 2) **New pipe reducer fittings:** Provide reducer fittings from the larger to the smaller pipe that are manufactured for that purpose and approved by the Public Works Director.
 - 3) **Existing pipe reducer fittings:** Where pipes of different materials as well as different sizes are joined, the reducer fitting material shall match the material of the larger pipe and approved by the Public Works Director.

2.6.13.2 REINFORCED CONCRETE PIPE

- A. Pipe support for pipe shall provide uniform bearing for the pipe barrel along its entire length. The pipe shall be carefully laid on the prepared foundation/bedding, groove end upgrade with the tongue fully inserted and each joint checked for alignment and grade as the work proceeds.
- B. Minimum pipe bedding class: See Section 2.3 – *Trenching, Backfilling, and Compaction of Utilities* for minimum bedding requirements.
- C. Pipe with varying wall class must not be mixed between manholes or boxes.
- D. Bury Limitations: The table below shall govern as the maximum allowable bury for concrete storm pipe:

Bury Limitations on RCP (15 through 60 inches)

Pipe Class	Maximum Depth of Bury ^a			Max Trench Width (feet)
	Class III (feet)	Class IV (feet)	Class V (feet)	
15-inch	9.5	14.5	23	4.0
18-inch	9.5	15.0	32.5	4.0
24-inch	11.5	23.0	50	4.0
30-inch	11.0	19.5	44.5	5.0
36-inch	10.5	18.0	35	6.0
42-inch	11.0	19.0	36.5	6.5
48-inch	11.5	19.5	37.5	7.0
54-inch	12.0	20.0	38.5	7.5
60-inch	12.0	20.5	38.5	8.0

^a Based on saturated clay weighing 120 pcf, trench width as specified, class C stone bedding, 1350 plf per ft of internal diameter for class III and 2000 plf per ft of internal diameter for class IV, 3000 plf per ft of internal diameter for class V, D-_{0.01 crack}

- E. Join concrete pipe using bitumastic material to seal joint.

As each joint is laid, visually inspect to be certain that no jointing compound gasket, or trash is protruding from the joint or lying inside the pipe.

2.6.13.3 DOUBLE WALL HIGH DENSITY POLYETHYLENE PIPE

- A. Pipe support for pipe shall provide uniform bearing for the pipe barrel along its entire length. Installations and pipe cover shall be in accordance with ASTM D2321 *Standard Practice for Underground Installation of Thermoplastic Pipe for Sewers and Other Gravity-Flow Applications*, the manufacturer's recommendations, and VDOT standards, whichever are more stringent.
- B. Minimum pipe bedding class: Bedding shall be in accordance with VDOT standards unless specified on the plan. 4" minimum bedding.
- C. Bury Limitations: Backfill material shall be placed alongside the pipe in uniform layers in lifts not to exceed 6" in depth. Backfill material shall be VDOT aggregate No. 25 or 26, aggregate base material size 21A or 21B, or flowable fill. Compaction shall meet VDOT standards and be in accordance with PFM Section 2.3 – *Trenching, Backfilling, and Compaction of Utilities* for minimum required site density testing.
- D. Filter fabric shall surround the aggregate fill material when there is a high water table or where the movement of groundwater can cause the migration of fines from the soil envelope. Provide an overlap of 2 feet minimum.
- E. The installer shall use flexible waterstops, resilient connections, or other flexible systems to make watertight connections to manholes and other structures in accordance with ASTM F2510/F2510M *Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures and Corrugated High Density Polyethylene Drainage Pipes* or ASTM C923 *Standard Specifications for Resilient Connectors Between Reinforced*

Concrete Manhole Structures, Pipes and Laterals. Grouting between the pipe manhole and other structures is not permitted.

2.6.14 MANHOLE CONSTRUCTION FOR STANDARD MANHOLES AND DROP INLET BASES

- A. **Standard Manholes and Drop Inlet Bases:** Manholes and drop inlet bases shall be constructed in accordance with **VDOT Road and Bridge Standards, Volume I and II** and as specified in the *VDOT Road and Bridge Specifications*, with the following exceptions:

Flexible boots and precast concrete inverts will not be required.

Joints will be as specified in the product section of this specification.

The pipe opening in precast units shall be at least 4 but not more than 8 inches larger than the outside diameter of the pipe. Pipe openings shall be formed, drilled, or neatly cut as approved by the Engineer.

The Contractor may use brick and masonry block or concrete pipe cutoffs in conjunction with mortar to fill the void between pipe culverts and precast structures. Such materials shall be thoroughly wetted and bonded with mortar. The remaining exterior and interior void shall be filled and sealed/slicked with mortar to the contour of the precast structure.

The standard joint shall be sealed on the interior of the structure, after installation, with a non-shrink hydraulic cement mortar per *VDOT Road and Bridge Specifications*, Section 218.

Unless directed otherwise by the Public Works Director, plug all weep holes with mortar.

Pour concrete inverts in all structures. Concrete shall be in compliance with products section for miscellaneous concrete of these specifications. Shape manhole channel with a smooth semicircular bottom matching inside diameter of the connecting pipe/pipes. Change directions of flow with a smooth curve of as large a radius as the manhole size will permit. Change size and grade of channels gradually and evenly. Shape the shelf to provide a slope between 1 and 2 inches per foot towards the invert.

Manholes shall be installed plumb.

- B. **Grade Rings/Adjustments:** The contractor shall exercise care in the ordering of structures so that the use of grade rings or brick for leveling and adjustments can be minimized. Where adjustment of a manhole is required, grade rings shall be used unless otherwise approved by the Public Works Director. Where adjustment of the inlet is required, the use of bricks or grade rings is approved, provided that the entire void between the flat-top and inlet is also filled with brick and mortar to uniformly distribute loading of the inlet. The combination of grade rings or depth of bricks shall not exceed 12 inches before removal of the cone or flat-top is necessary for adjustment.

On all storm manholes, a mastic joint material shall be placed between the frame and cover and the cone or grade ring.

C. Replacement/Rehabilitation of Existing Manholes:

When a new manhole is necessary, the old manhole must be completely removed and a new precast manhole constructed in its place. Where the old manhole is of satisfactory quality, the Contractor will make connection thereto as directed by the Public Works Director at no additional cost even if it is necessary to modify the bottom of the manhole to meet the new grade. Such extras are considered to be incidental to the manhole connection cost.

2.6.15 INLET CONSTRUCTION AND MISCELLANEOUS APPURTENANCES

Construct inlets, end walls, and other storm drainage items as detailed in the latest edition of the **VDOT Road and Bridge Standards, Volume I and II** and as specified in *VDOT Road and Bridge Specifications*, latest revision.

Adjusting inlet tops and/or miscellaneous appurtenances shall follow same guidelines as prescribed in 3.2, *Manhole Construction for Standard Manholes and Drop Inlet Bases*, paragraph B. *Grade Rings/Adjustments*, above.

2.6.16 ABANDONING STORMLINES & MANHOLES

- A. **Storm lines:** When an existing storm line is designated to be abandoned in place, the low end of the line is to be plugged and lean concrete grout (flowable fill) pumped into the line until line is completely filled.
- B. **Manholes:** When an existing manhole, either partially or wholly, is designated to be abandoned and the storm lines, either entering or exiting the manhole, have been abandoned according to the preceding paragraph, the upper portion of the manhole shall be removed to a minimum of 18 inches below the proposed finished grade, or as determined by the Public Works Director, VDOT #57 stone dumped into the manhole, and the stone vibrated to consolidate the stone. The remainder of the fill between the top of the manhole and the finished subgrade is to be backfilled as follows. Where the manhole is located within a roadway right of way, backfill with VDOT # 57 Stone and consolidate. Outside roadway right of ways, filter fabric shall be placed over the stone, suitable material of a compactable nature shall be placed over the top of the manhole, and the material tamped.

2.6.17 SLOPE ANCHORS

All lines on slopes equal to or greater than 20% slope shall have concrete anchors placed around the pipe directly below the bell end of the line. The anchors shall be spaced every other joint unless otherwise shown on the plans and constructed to the dimensions shown in **VDOT Road and Bridge Standards, Volume I and II**.

2.6.18 EXCAVATION OF DRAINAGE CHANNELS

- A. Open storm drainage channels and ditches shall be graded and shaped in accordance with the elevations, slopes, widths, and lengths indicated on the plans. The outfall elevation of the new channels and ditches shall be graded to match the flow elevations of all existing or natural channels, unless indicated or specified otherwise.

- B. The drainage channels shaped with fill materials shall be compacted within the limits and in accordance with the related backfill work specified elsewhere.
- C. The drainage channels shall be prepared, seeded, and mulched in accordance with the related work specified elsewhere. Where indicated or specified, erosions control measures, such as temporary liners, riprap, concrete, etc., shall be provided.

2.6.19 PLACEMENT OF RIP RAP AND RIP RAP BEDDING

Placement of Rip Rap and fabric shall conform to the latest edition of the **VDOT Road and Bridge Standards, Volume I and II** and as specified in *VDOT Road and Bridge Specifications*, latest revision.

2.6.20 SUBSURFACE DRAINAGE

Installation of subsurface drainage systems shall conform to the latest edition of the **VDOT Road and Bridge Standards, Volume I and II** and as specified in *VDOT Road and Bridge Specifications*, latest revision using non-woven needle-punched fabric.

2.6.21 INSPECTION

Upon completion of entire pipe installation, the Public Works Director may inspect the work in part or as a whole as will satisfy himself/herself that every portion of the contract has been faithfully carried out in accordance with the plans, specifications, and standard details, as applicable.

If, in the opinion of the Public Works Director, a defect exists in the pipeline or its appurtenances, in some place not accessible except by uncovering, the Public Works Director may order the line to be uncovered. If it is found that after the pipe has been uncovered at the order of the Public Works Director, no defect exists or that the defects were not the fault of the contractor, then the expense so incurred by the contractor shall be borne by the City.

Flush all sand, dirt, and debris from the lines prior to inspection. Provide lights and mirrors and inspect lines in the presence of the Construction Coordinator.

Inspect the system for conformance with line and grades shown on the plans and provide record drawing measurements on record drawings.

Visual Inspection: All lines and manholes shall be visually inspected by the City of Fairfax from every manhole by use of mirrors or television cameras. At the direction of the Public Works Director, areas of questionable construction may be inspected by the City using television cameras. The lines shall exhibit a fully circular pattern when viewed from one manhole to the next. Lines, which do not exhibit a true and correct line and grade, have obstruction or structural defects, shall be corrected to meet these specifications and the barrel left clean for its entire length.

Laying Tolerance: Place pipe to the grades and alignment shown on the plans and within a tolerance of 1:1000 vertical and 1:500 horizontal, unless otherwise directed by the Public Works Director. The vertical elevation difference between manholes and/or the terminal end of pipe runs shall be no less than 75% and no more than 125% of the design vertical elevation difference, unless otherwise approved or directed by the Public Works Director.

2.6.22 MAINTENANCE

The developer shall maintain all pipe installations in such a condition that they will function continuously from the time the pipe is installed until the development/project is accepted for maintenance by the City. Furthermore, soil erosion and sedimentation control measures shall be installed wherever necessary, including at curb inlets for example, and maintained for the duration of the development until the project is fully stabilized. Once permanent groundcover has been established, temporary erosion control measures shall be removed and the disturbed areas landscaped and seeded.

2.6.23 MEASUREMENT & PAYMENT

See [Section 2.1 – Measurement and Payment](#).

END OF SECTION 2.6

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